

# **Spot Safety Project Evaluation**

Project Log # 200712093

Spot Safety Project # 12-01-234

## **Spot Safety Project Evaluation of the Traffic Signal Installation At the Intersection of US 21 / NC 115 (Charlotte Hwy) and I-77 Northbound Ramps at Exit 42 Iredell County**

Documents Prepared By:

Safety Evaluation Group  
Traffic Safety Systems Management Section  
Traffic Engineering and Safety Systems Branch  
North Carolina Department of Transportation

**Principal Investigator**

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Jason B. Schronce

3-27-2008  
Date

Traffic Safety Project Engineer

# ***Spot Safety Project Evaluation Documentation***

## **Subject Location**

Evaluation of Spot Safety Project Number 12-01-234 – The Intersection of US 21 / NC 115 (Charlotte Highway) and I-77 Northbound Ramp access at Exit 42 in Iredell County.

## **Project Information and Background from the Project File Folder**

The spot safety project improvement countermeasure chosen for the subject location was the installation of an actuated traffic signal. In the study period, US 21 / NC 115 was a 4 four lane concrete median divided highway that provided a westbound left turn lane and an eastbound right merge lane at the I-77 northbound ramp access. Interstate 77 Exit 42 northbound off-ramp provides a single left turn lane and a right turn slip onto US 21 at the subject intersection. The subject location is a three-leg intersection, which was controlled by stop signs on the off-ramp terminal. There was also a median break approximately 0.25 miles east of the ramp access for the Wilco Travel Plaza driveway.

In the first quarter of 2008, roadway geometry changes were made to this segment by developers of commercial property across from the Wilco Travel Plaza with the building of a Lowes Home Improvement Store. The changes include installing a signal at Lexus Drive (the back entrance to the Wilco Travel Plaza outside the study limits), adding a double left turn off the ramp, and blocking the median opening for the Wilco Travel Plaza.

The original statement of problem was the significant angle and left turn crash pattern at the ramp intersection. Also, queuing on the off-ramp during peak hours was causing traffic issues back on Interstate 77. The intersection met signal warrants 1A, 1B, 2 and 3B.

The initial crash analysis was completed from April 1, 1998 to March 31, 2001 with twenty (20) reported crashes, fifteen (15) of which were deemed correctable with the proposed countermeasure. The final completion date for the improvement at the subject intersection was on October 8, 2002 with a total cost of \$75,000.00.

## **Naive Before and After Analysis**

After reviewing the spot safety project file folder along with all the crashes at the subject location, the crash data omitted from this analysis to consider for an adequate construction period was from September 1, 2002 to November 30, 2002. The before period consisted of reported crashes from December 1, 1997 through August 31, 2002 (4 years and 9 months) and the after period consisted of reported crashes from December 1, 2002 through August 31, 2007 (4 years and 9 months). The ending date for this analysis was determined by the date of available crash data at the time of analysis.

The treatment data at both locations consisted of all crashes within 150 feet of the subject intersection. There were no crashes located outside 150 feet between the two different study locations. *Please see attached location map, site photos, and collision diagrams for further details.*

The following data table depicts the Naive Before and After Analysis for the treatment location. Please note that Frontal Impact Crashes at the signalized intersection within 150 feet were the target crashes for the applied countermeasure. The Frontal Impact Crash types considered are as follows: Left turn, same roadway; Left turn, different roadways; Right turn, same roadway; Right turn, different roadways; Head on; and Angle.

<b>Table 1: Treatment Information – Countermeasure Signal at Ramps</b>			
	<b>Before</b>	<b>After</b>	<b>Percent Reduction (-) Percent Increase (+)</b>
Total crashes	32	20	- 37.50 %
Total Severity Index	6.61	4.70	- 28.90 %
Target Crashes	27	6	- 66.67 %
Target Crash Severity Index	7.37	3.47	- 52.92 %
Volume	11,000	13,600	23.64 %
<b><u>Injury Crash Summary</u></b>			
Fatal injury Crashes	0	0	N/A
Class A injury Crashes	1	0	- 100.00 %
Class B injury Crashes	8	1	- 87.50 %
Class C Injury Crashes	6	9	50.00 %
Total Injury Crashes	15	10	- 33.33 %

<b>Table 2: Wilco Plaza Entrance – Median Opening</b>			
	<b>Before</b>	<b>After</b>	<b>Percent Reduction (-) Percent Increase (+)</b>
Total crashes	41	14	- 65.85 %
Total Severity Index	8.85	3.64	- 58.87 %
<b><u>Injury Crash Summary</u></b>			
Fatal injury Crashes	1	0	- 100.00 %
Class A injury Crashes	1	0	- 100.00 %
Class B injury Crashes	6	2	- 66.67 %
Class C Injury Crashes	17	3	- 82.35 %
Total Injury Crashes	25	5	- 80.00 %

The naive before and after analysis at the treatment location resulted in a 37.5 percent decrease in Total Crashes at the subject intersection, a 67 percent decrease in Target Crashes, and a 29 percent decrease in the Total Severity Index. The before period ADT year was 2000 and the after period ADT year was 2005.

## Results and Discussion

The naive before and after analysis involving the comparison of treatment actual before data versus treatment actual after data resulted in a 37.5 percent decrease in Total Crashes and a 67 percent decrease in Target Crashes. The summary results above demonstrate that both Total Crashes and Target Crashes appear to have decreased at the treatment location from the before to the after period.

Referencing the *Collision Diagrams*, a significant portion of crashes at the ramp intersection in the before period (21 of 32) were the result of a vehicle improperly turning left across eastbound US 21 traffic. After the signal installation, this pattern was significantly reduced to just four (4), which mainly resulted from eastbound vehicles on US 21 running the red light. There was also a slight increase in Rear-End Crashes at the intersection (from 1 to 7).

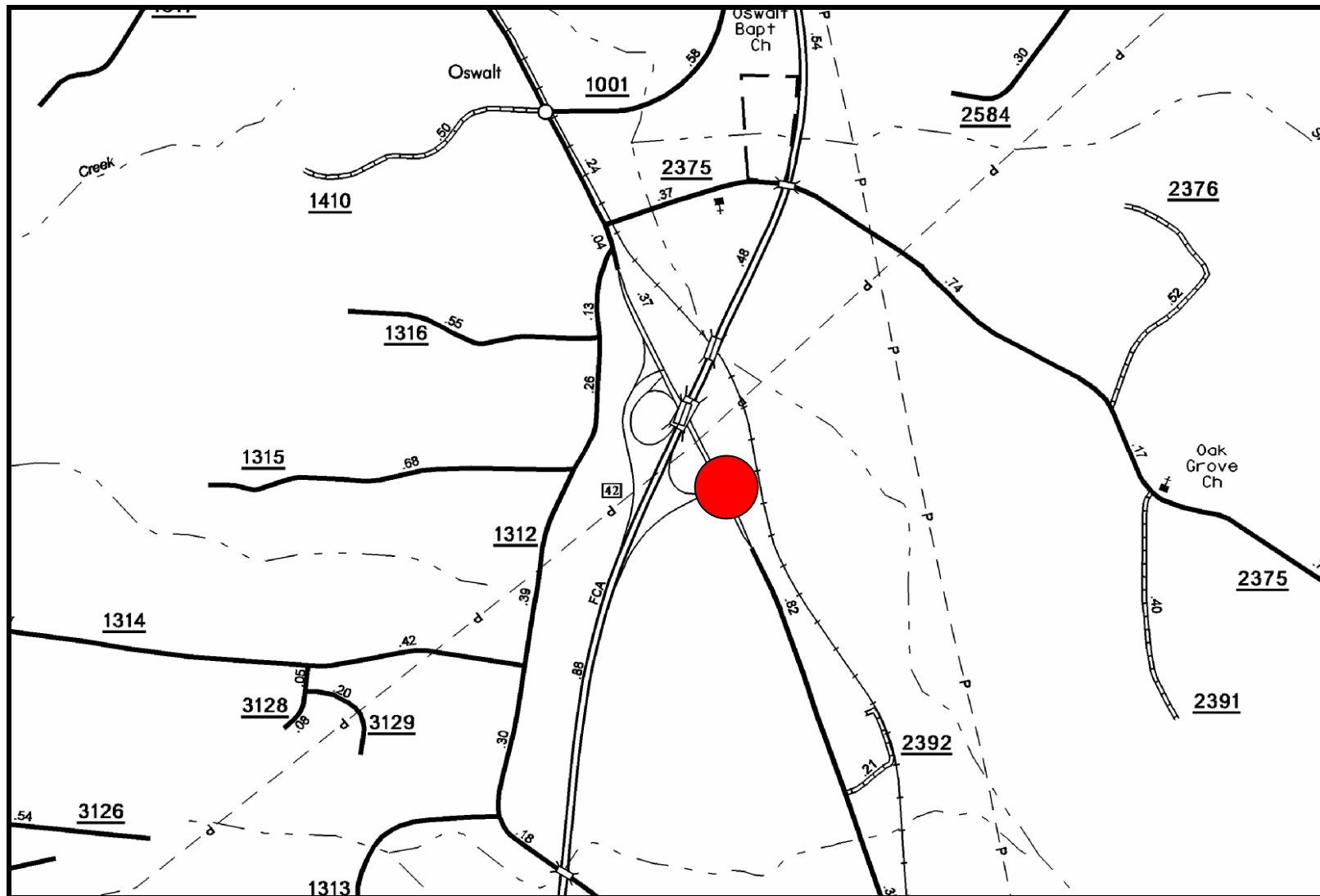
The major benefit of the project appears to have occurred at the Wilco Travel Plaza entrance. The signal installation possibly created traffic gaps that have allowed vehicles to enter and leave this PVA with additional safety. From the before to the after period analysis, we have seen a crash reduction of nearly 66 percent at this median opening with a severity index reduction of 59 percent. This pattern should now be completely eliminated based off the closing of the concrete median due to the signal at Lexus Drive to the east upon our field investigation.

The calculated benefit to cost ratio for the ramp signal is 8.84 considering total crashes. The benefit to cost ratio considering only target crashes at the ramp signal is 10.81. The benefits are calculated using the change in annual crash costs from the before to the after period. Operational and other benefits related to the project are not considered in this analysis. The costs of the project include the actual construction costs as well as the increase in annual maintenance and utility costs.

Please see the attached *Treatment Site Photos*. Photos are provided for all approaches to the treatment intersection, although the configuration of US 21 shown is different from the configuration that was analyzed for this study, as explained in the *Project Background* section. The photos included also show the new 2008 signalized intersection of Lexus Drive as well as double left turns from the ramp terminal.

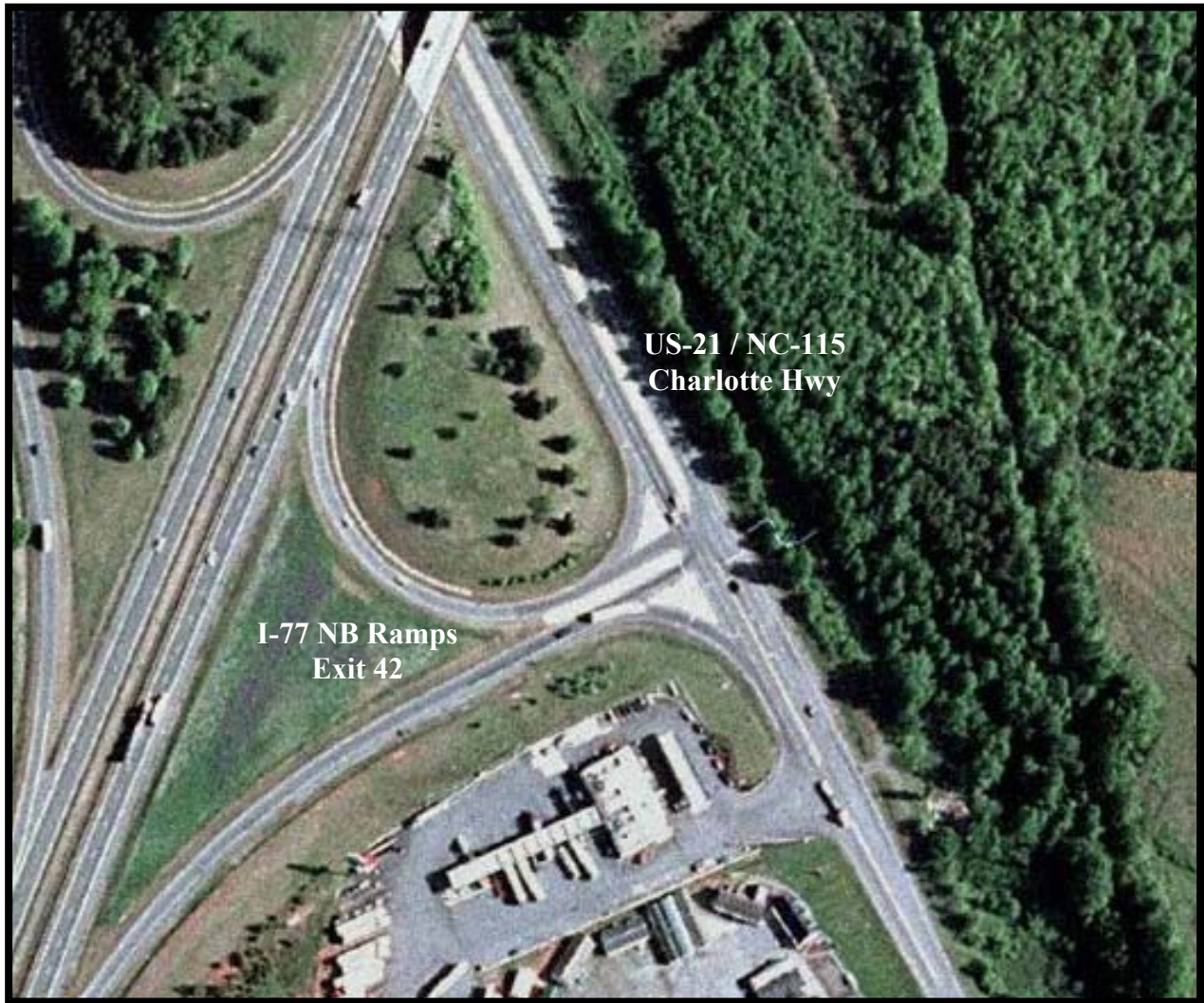
As the Safety Evaluation Group completes additional spot safety reviews for this type of countermeasure, we will be able to provide objective and definite information regarding actual crash reduction factors for this type of intersection.

**Location Map  
Iredell County  
Evaluation of Spot Safety Project # 12-01-234**



**Treatment Location: I-77 Exit 42 NB Ramps at US 21 / NC 115 (Charlotte Hwy)**

**SS# 12-01-234**  
**Aerial Image**  
**Iredell County**



## **TREATMENT SITE PHOTOS TAKEN 3-17-2008**



Traveling North on I-77 Exit 42 NB Off-Ramp



Traveling East on US-21 at I-77 Ramp Signal





Traveling East on US-21 at Wilco Plaza Entrance



Traveling East on US-21 at Lexus Drive New Signal (Lowes to the left)





Traveling West on US-21 approaching Lexus Drive New Signal



Traveling West on US-21 at Wilco Plaza to the left



Traveling West on US-21 approaching I-77 Ramp Signal



Traveling North on Lexus Drive (Back Entrance to Wilco Plaza)

# BENEFIT-COST ANALYSIS WORKSHEET

LOCATION: US-21 at I-77 NB Ramps  
COUNTY: Iredell  
FILE NO.: SS 12-01-234

BY: JBS  
DATE: 3/24/2008  
NOTES: Total Crashes at Signalized Intersection

DETAILED COST: TYPE IMPROVEMENT - New Signal

ITEMS	TOTAL	SERVICE	CRF	ANNUAL COST
Construction	\$75,000	10	0.149	\$11,177
	\$0	0	0.000	\$0
Right-of-Way	\$0	0	0.000	\$0

TOTALS	\$75,000	10	0.149	\$11,177
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ESTIMATED INCREASE IN ANNUAL MAINT. COST =	\$2,200
ESTIMATED INCREASE IN ANNUAL UTILITY COST =	\$900
TOTAL ANNUAL COST=	\$14,277
TOTAL COST OF PROJECT=	\$75,000

## COMPREHENSIVE COST REDUCTION:

### ESTIMATED NUMBER OF ANNUAL ACCIDENT DECREASES

TIME PERIOD	YEARS	K & A CRASHES	K & A CRASHES PER YR	B & C CRASHES	B & C CRASHES PER YR	PDO CRASHES	PDO CRASHES PER YR	ANNUAL COSTS
BEFORE	4.75	1	0.21	14	2.95	17	3.58	\$172,274
AFTER	4.75	0	0.00	10	2.11	10	2.11	\$46,105

Annual Benefits from Crash Cost Savings \$126,168

NET AVG. ANNUAL BENEFITS = AVG. ANNUAL BENEFITS - TOTAL ANNUAL COST = \$111,891

BENEFIT-COST RATIO = AVG ANNUAL BENEFITS/TOTAL ANNUAL COST = 8.84

TOTAL COST OF PROJECT - \$75,000 COMPREHENSIVE B/C RATIO - 8.84

# BENEFIT-COST ANALYSIS WORKSHEET

LOCATION: US-21 at I-77 NB Ramps  
COUNTY: Iredell  
FILE NO.: SS 12-01-234

BY: JBS  
DATE: 3/24/2008  
NOTES: Target Crashes - Frontal Impact with Signal Study Limits

DETAILED COST: TYPE IMPROVEMENT - New Signal

ITEMS	TOTAL	SERVICE	CRF	ANNUAL COST
Construction	\$75,000	10	0.149	\$11,177
	\$0	0	0.000	\$0
Right-of-Way	\$0	0	0.000	\$0
TOTALS	\$75,000	10	0.149	\$11,177

ESTIMATED INCREASE IN ANNUAL MAINT. COST =	\$2,200
ESTIMATED INCREASE IN ANNUAL UTILITY COST =	\$900
TOTAL ANNUAL COST=	\$14,277
TOTAL COST OF PROJECT=	\$75,000

## COMPREHENSIVE COST REDUCTION:

### ESTIMATED NUMBER OF ANNUAL ACCIDENT DECREASES

TIME PERIOD	YEARS	K & A CRASHES	K & A CRASHES PER YR	B & C CRASHES	B & C CRASHES PER YR	PDO CRASHES	PDO CRASHES PER YR	ANNUAL COSTS
BEFORE	4.75	1	0.21	13	2.74	13	2.74	\$165,200
AFTER	4.75	0	0.00	2	0.42	4	0.84	\$10,863

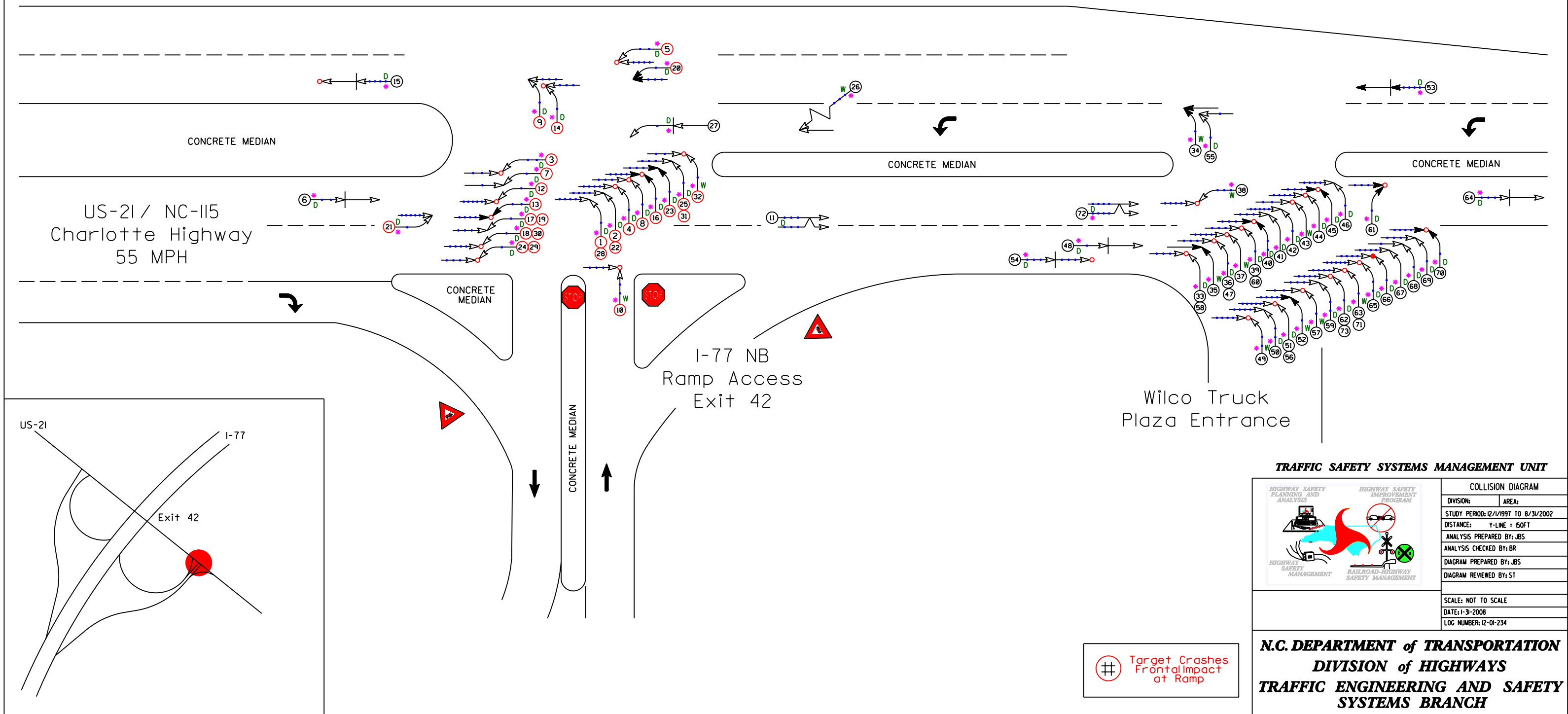
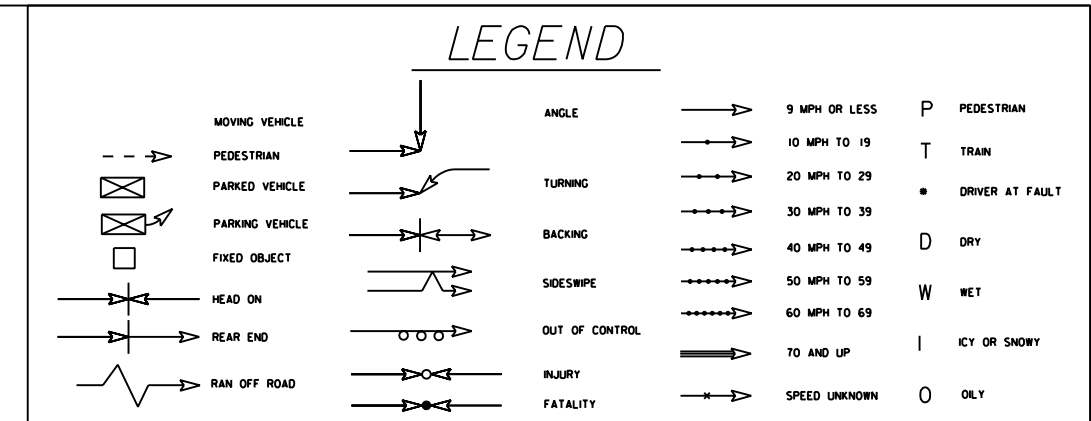
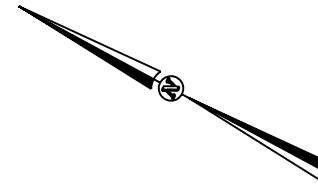
Annual Benefits from Crash Cost Savings \$154,337

NET AVG. ANNUAL BENEFITS = AVG. ANNUAL BENEFITS - TOTAL ANNUAL COST = \$140,060

BENEFIT-COST RATIO = AVG ANNUAL BENEFITS/TOTAL ANNUAL COST = 10.81

TOTAL COST OF PROJECT - \$75,000 COMPREHENSIVE B/C RATIO - 10.81

SS# 12-01-234  
Iredell County  
BEFORE Period  
12/1/97 - 8/31/02



SS# 12-01-234  
Iredell County  
AFTER Period  
12/1/02 - 8/31/07

